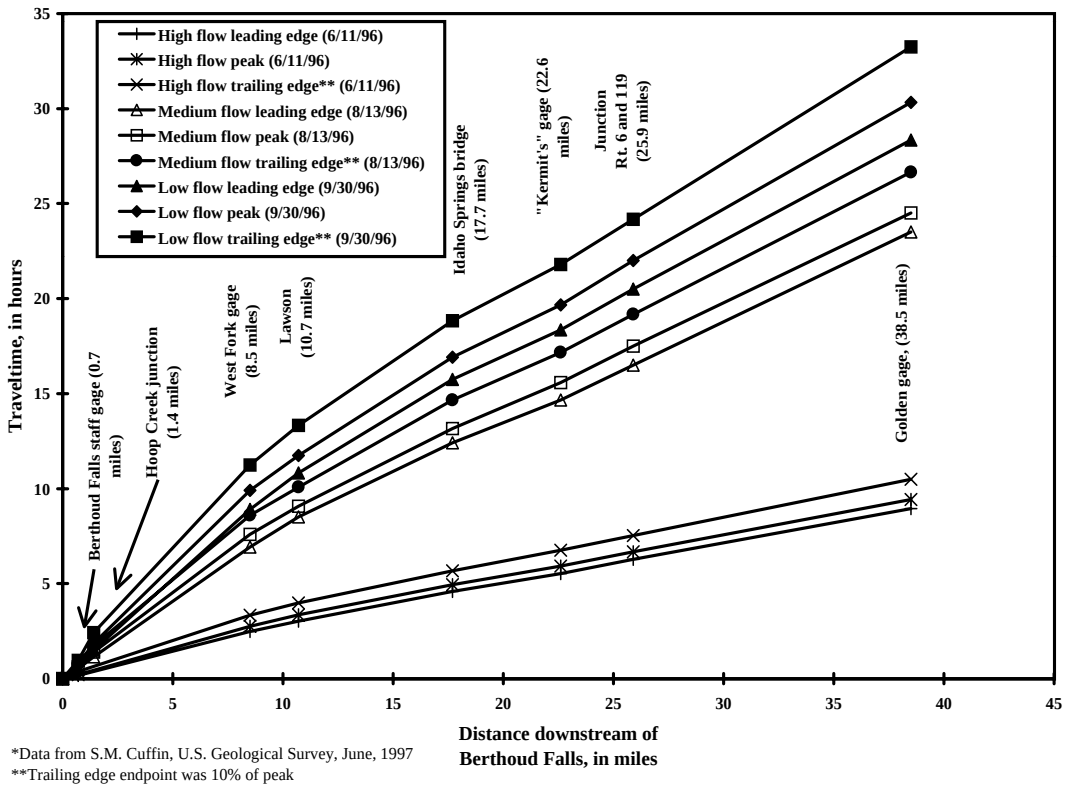


*Data from S.M. Cuffin, U.S. Geological Survey, June, 1997
**Trailing edge endpoint was 10% of peak

TIME-OF-TRAVEL IN CLEAR CREEK

The U.S. Geological Survey, the Colorado Department of Transportation, and the Upper Clear Creek Watershed Association have conducted studies to determine how long it takes for water in Clear Creek to move from locations at the top of the watershed to the City of Golden. This graph shows the time it takes water to travel from Berthoud Falls on the West Fork of Clear Creek to Golden. During high flows, water will move from Berthoud Falls to Golden in less than ten hours. During low flow, it takes nearly 30 hours. When a spill occurs in Clear Creek, this information can be used by downstream water suppliers to calculate how long it will take for the spill to reach water supply intakes. These data were provided by S.M. Cuffin of the U.S. Geological Survey, June 1997.

VII. STREAM INFORMATION BY GEOGRAPHIC REGION

Main Stem to West Fork

The headwaters of Clear Creek are found along the Continental Divide near Loveland Pass, the Eisenhower Tunnel, and Loveland Ski Area. The river flows through the historic towns of Silver Plume and Georgetown then through Georgetown Lake toward its confluence with the West Fork of Clear Creek. Map 11 shows this area.

Above Silver Plume, Clear Creek is a pristine mountain stream. The river begins to show the influence of historic mining near the Burleigh Tunnel in Silver Plume. Downstream of Silver Plume, Clear Creek flows along Interstate-70 into Georgetown Lake. Not much is known about the effects of Georgetown Lake on Clear Creek water quality. At times, however, there is fairly poor water quality immediately downstream of the lake. The U.S. Geological Survey, EPA, CDPHE, and the Upper Clear Creek Watershed Association are planning to study Georgetown Lake more closely in 1997 and 1998.

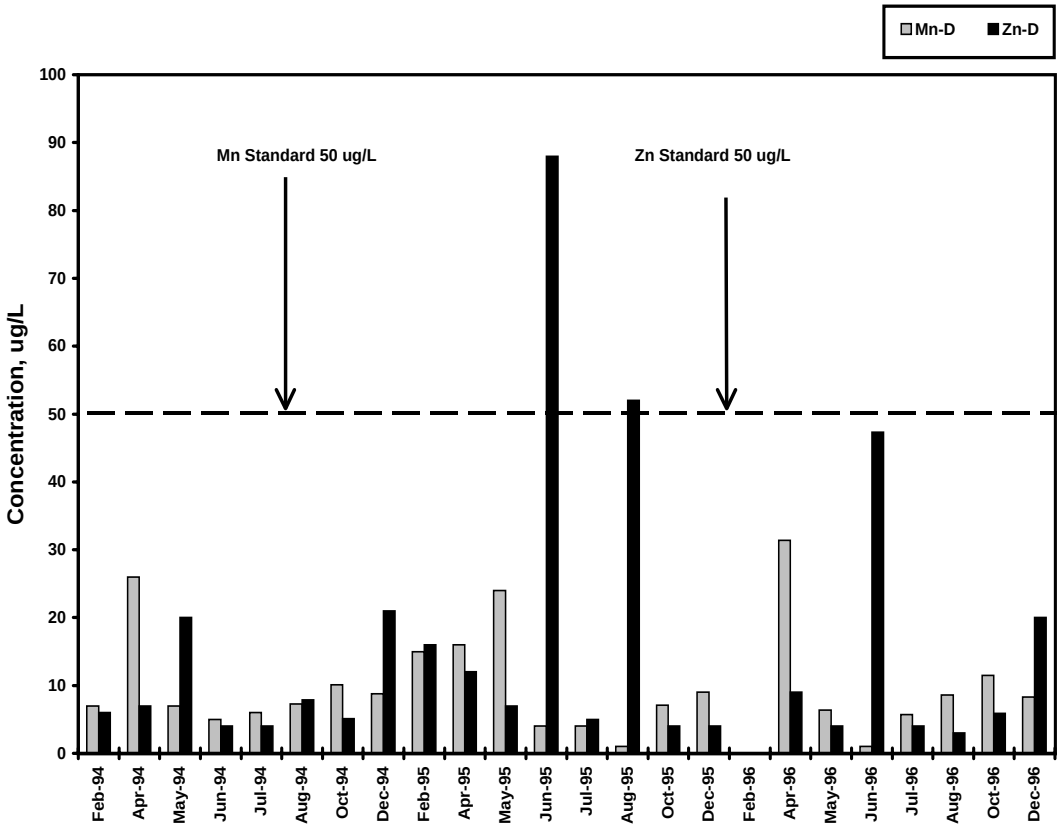
CDOW has found several fish species in this geographic region of Clear Creek including rainbow, brook, brown, and Snake River cutthroat trout. The best populations of brook and brown trout are found along the main stem of Clear Creek from the confluence with the South Fork to the confluence with the West Fork of Clear Creek. Catchable-size rainbows and fingerling Snake River cutthroat are stocked by CDOW from Silver Plume upstream to Bakerville. In cooperation with the USDA Forest Service, CDOW installed in-stream habitat improvement structures near Bakerville to enhance fish survival, growth, and reproduction.

Small brook, brown, and cutthroat trout were found in Georgetown Lake by CDOW in 1988 and 1989. This may indicate that these types of trout are successfully reproducing in the lake or in an upstream location since these types of trout were not stocked in those years.

The boreal toad is a state-threatened species and a USDA Forest Service species of special concern. Two successful breeding areas for boreal toads are found west of Silver Plume along the Interstate-70 corridor. Adult and juvenile toads are found in this area; however, specific population numbers are not known.

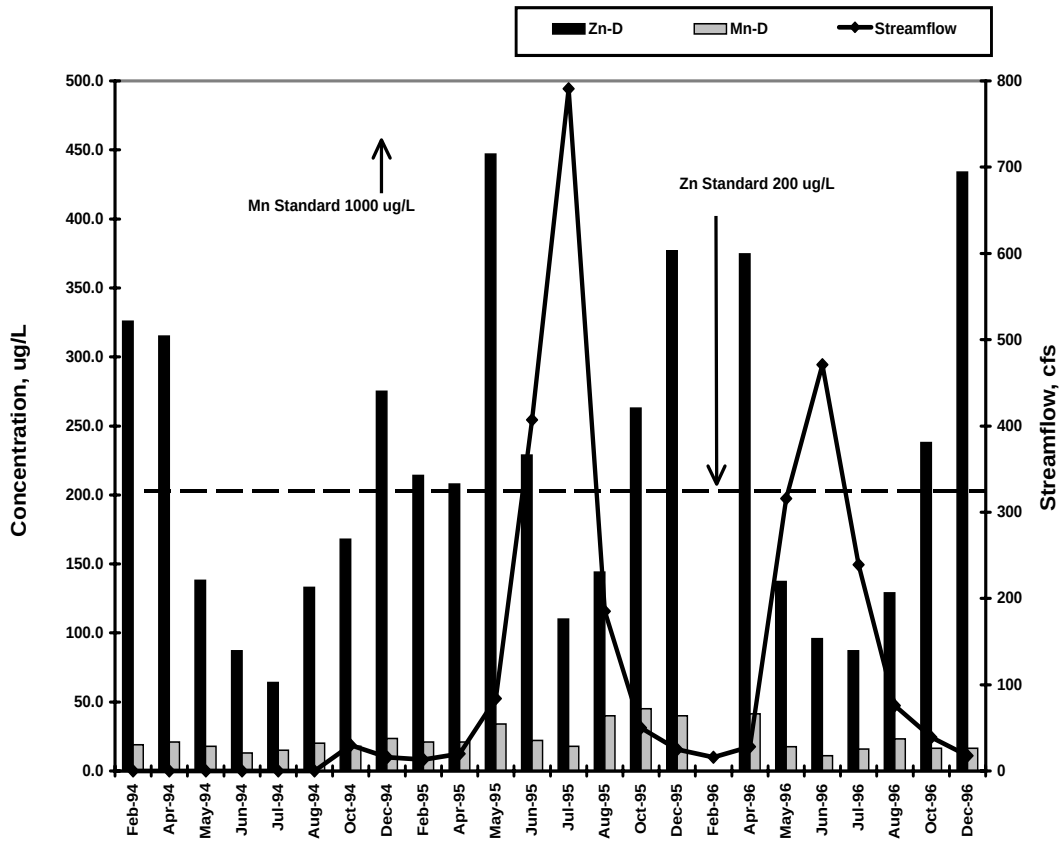
DISSOLVED ZINC AND DISSOLVED MANGANESE AR BAKERVILLE

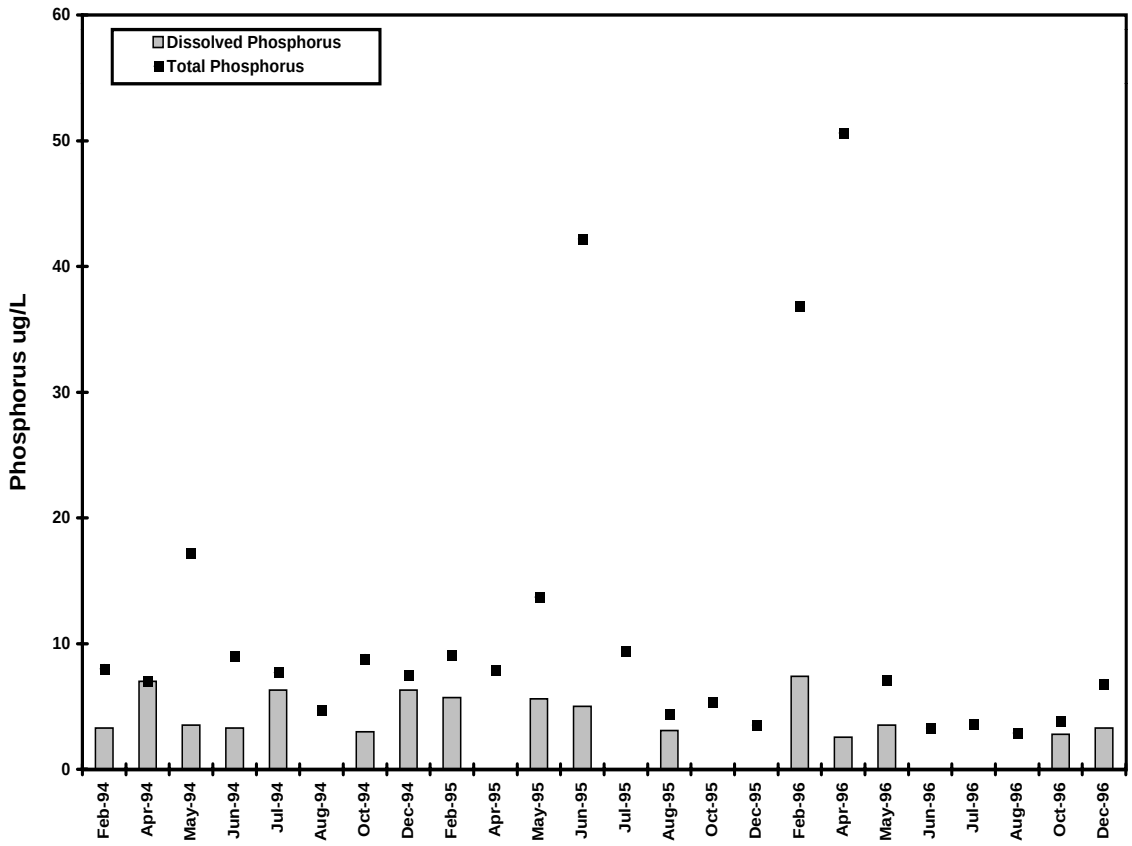
This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-05 shown on Map 11. Some of the best water quality in Clear Creek exists here, towards the top of the watershed. Zinc has at times, however, exceeded the state stream standard, usually during the annual spring runoff. The zinc standard is determined by a formula which depends upon hardness. A hardness of 40 mg/L as calcium carbonate was used to calculate the zinc standard. This monitoring station is located in Stream Segment #1 for the Clear Creek basin. Stream segments and the water quality standards for each of those segments are designated by the Colorado Water Quality Control Commission. (See Map 8.) The Commission also designates uses for each stream segment. (See Table 9.) Because of the water supply use designation for this stream reach, the stream standard for manganese is the same as the secondary drinking water standard of 50 ug/L.



DISSOLVED ZINC AND MANGANESE IN CLEAR CREEK UPSTREAM OF THE WEST FORK

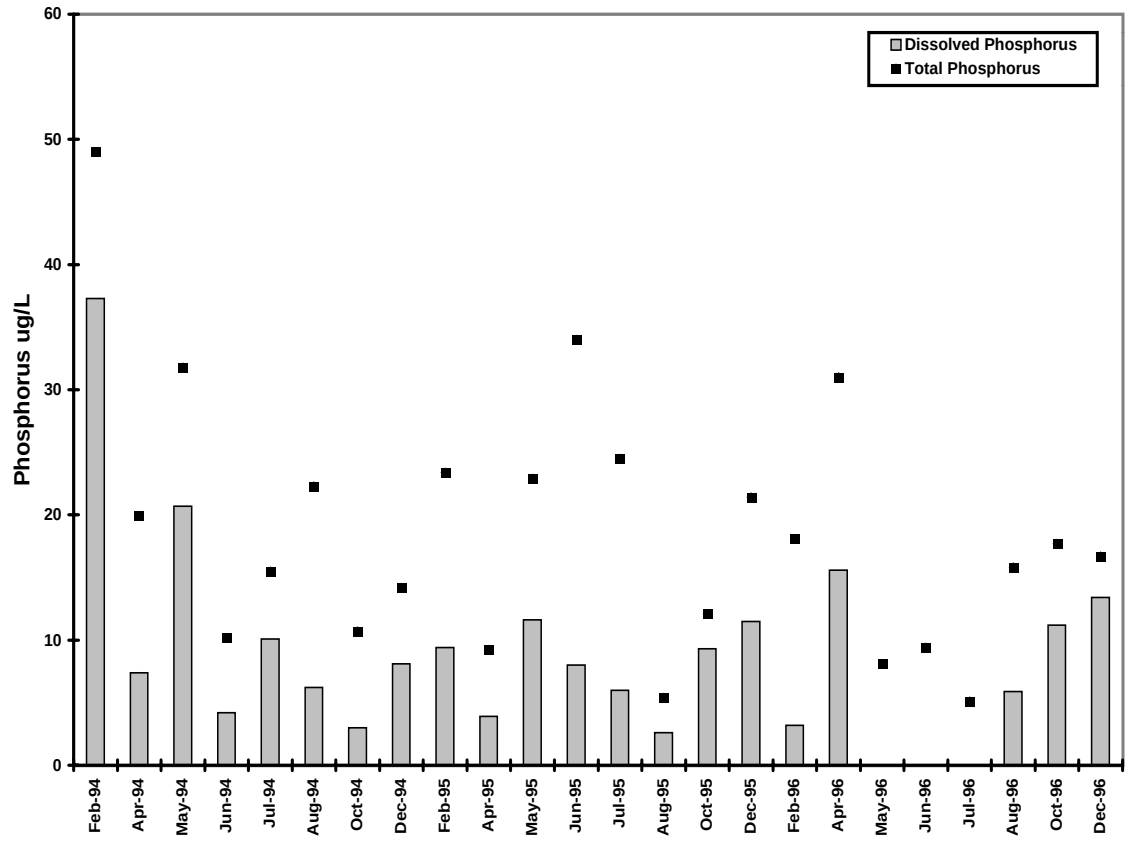
This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-25 shown on Map 11. Since this monitoring station is located at the stream gage upstream of the confluence with the West Fork, stream flow information is available. Manganese levels at this location on Clear Creek are not a concern. Zinc levels, however, exceed the state stream standard at many times during the year. This monitoring station is located in Stream Segment #2 for the Clear Creek basin. Because water supply is not one of the designated uses for this segment, the manganese standard is set at 1000 ug/L for the protection of aquatic life.





PHOSPHORUS AT BAKERVILLE

This graph shows dissolved and total phosphorus at monitoring station CC-05, near Bakerville. The monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Clear Creek.



PHOSPHORUS IN CLEAR CREEK UPSTREAM OF THE WEST FORK

This graph shows dissolved and total phosphorus at monitoring station CC-25. This monitoring station is located on Clear Creek at the stream gage upstream of the confluence with the West Fork. The nutrient monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Clear Creek.

CHALLENGE: *The Burleigh Tunnel, a mine drainage tunnel for the historic mining district near Silver Plume, introduces on average 43 pounds of zinc per day into Clear Creek. Through the Superfund program, EPA and CDPHE built a trial constructed wetland to determine if a wetland would be effective in removing zinc and other metals from the mine drainage. Despite initially promising results, the wetland has failed to live up to expectations. EPA and CDPHE are evaluating why the system was not as efficient as expected. Possibilities include cold weather and maintenance problems. EPA and CDPHE are considering what to do next with the Burleigh Tunnel discharge.*

EPA and CDPHE estimate that there are an additional ten pounds of zinc per day entering Clear Creek from groundwater in the vicinity of Silver Plume. This type of non-point source pollution is very difficult to address and, at this time, there are no plans by any organization to investigate further.

South Fork of Clear Creek

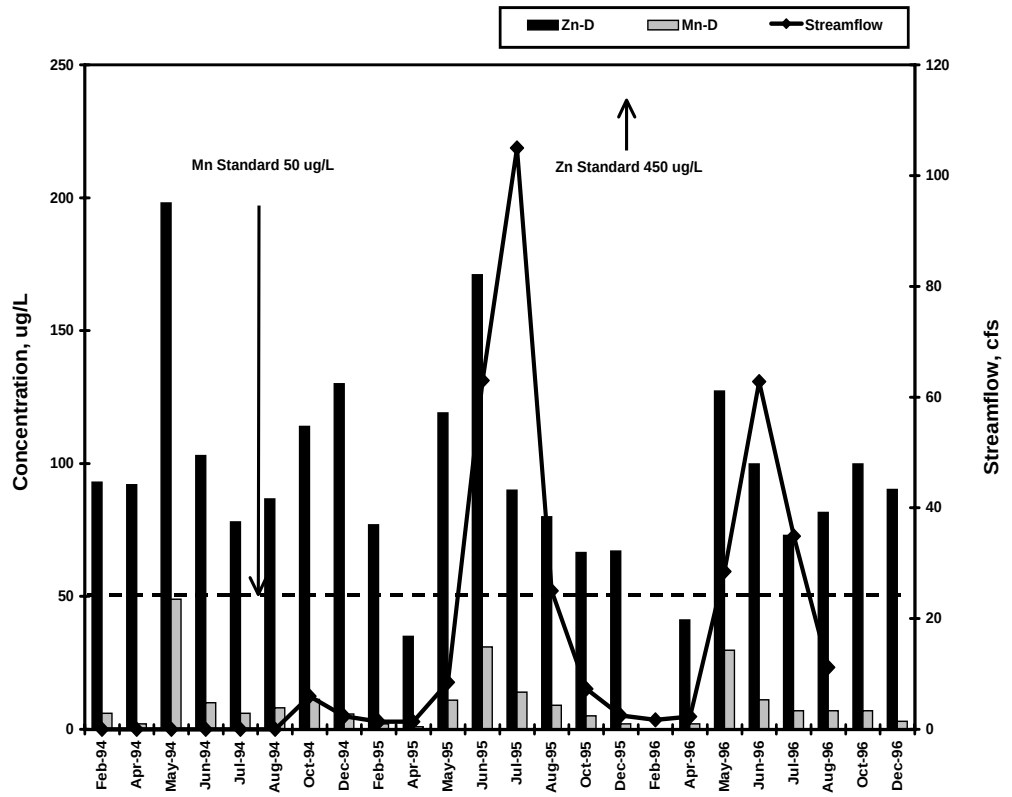
The South Fork of Clear Creek is approximately eight miles long and is located south and west of Georgetown. The South Fork joins Clear Creek in Georgetown. The South Fork has one major tributary, Leavenworth Creek. There are several lakes and reservoirs on the South Fork. (See Map 11.)

The water quality in the South Fork is relatively good compared with other Clear Creek tributaries. Leavenworth Creek, however, has been impacted by past mining activity close to the creek's headwaters near Argentine Pass.

Catchable-size rainbows are periodically stocked by CDOW in the South Fork from Clear Lake up to Guanella Pass Campground. Upper Leavenworth Creek does not support a strong population of fish, possibly due to zinc toxicity from nearby mines. A good brook trout fishery was found in lower Leavenworth Creek, and this area was stocked with brook trout by CDOW in 1990.

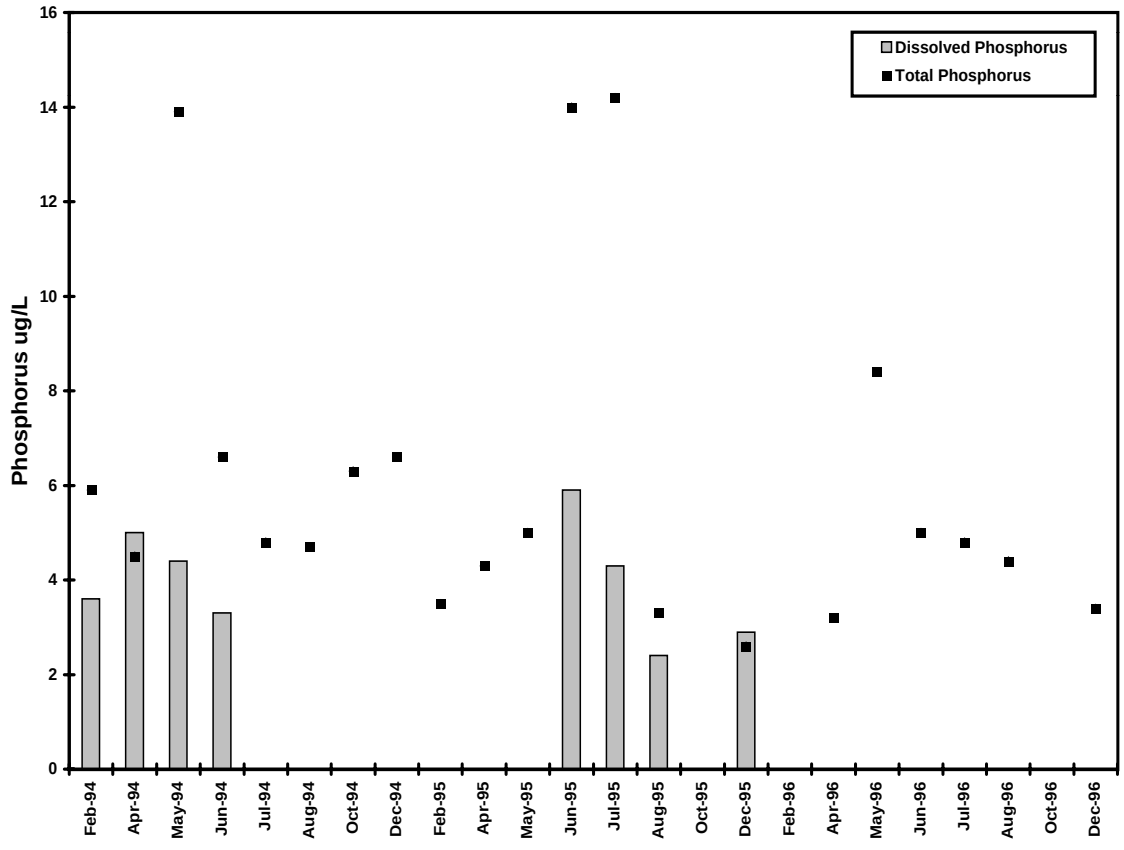
CHALLENGE: *The Waldorf mine, situated on Leavenworth Creek, would seemingly be a simple mine site to clean up. From a construction standpoint, this is true. What makes the cleanup of the Waldorf and other similar orphan mine sites difficult is the complex network of land ownership so prevalent in the Clear Creek watershed and elsewhere in the state. Mining claims, which are normally no larger than 300 feet by 1500 feet, cover a good share of the watershed leaving behind pie-like slices of federal land to be administered by the USDA Forest Service. The Waldorf mine has a mix of unpatented mine claims, private land, and USDA Forest Service-managed land. This complicates issues of access and responsibility for cleanup.*

THE WALDORF MINE
One of many old mining sites in the watershed.



DISSOLVED ZINC AND DISSOLVED MANGANESE IN LEAVENWORTH CREEK

This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-10 shown on Map 11. Leavenworth Creek is a tributary to South Clear Creek. Stream flow data are available because there is a stream gage on Leavenworth Creek. The water in Leavenworth Creek contains elevated levels of zinc, but very little manganese. A possible source of the zinc is the Waldorf Mine which is situated at the headwaters of Leavenworth Creek. The Colorado Water Quality Control Commission has set a zinc standard of 450 ug/L on Leavenworth Creek to reflect the current impacted state of the water. This monitoring station is located in Stream Segment #3b for the Clear Creek basin. Because of the water supply designation for this stream reach, the stream standard for manganese is the same as the secondary drinking water standard of 50 ug/L.



PHOSPHORUS IN LEAVENWORTH CREEK

This graph shows dissolved and total phosphorus at monitoring station CC-10, which is located on Leavenworth Creek. The nutrient monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Leavenworth Creek.

West Fork of Clear Creek

The headwaters of the West Fork of Clear Creek are located at Jones Pass near Berthoud Pass. The West Fork is approximately 12 miles long. The West Fork flows through the town of Empire on its way to its confluence with Clear Creek. Map 11 shows this area.

The highest quality habitat in the Clear Creek watershed is in the West Fork. The boreal toad is found at several locations in the West Fork drainage. Studies conducted by CDOW have found cutthroat and brook trout in the West Fork and the trout population is expected to increase as water quality in the West Fork improves.

Bard Creek, a tributary of the West Fork, is a catch and release greenback cutthroat trout stream. Greenback cutthroats are a federally-threatened species. CDOW and the U.S. Fish and Wildlife Service have completed habitat improvements in Bard Creek to enhance the survival and reproduction of the greenbacks. Greenbacks are very sensitive to zinc and the levels of zinc in Bard Creek are high enough that the species does not reproduce there. Special fishing regulations, fly and lure only, apply on Bard Creek. All fish caught in Bard Creek must be released.

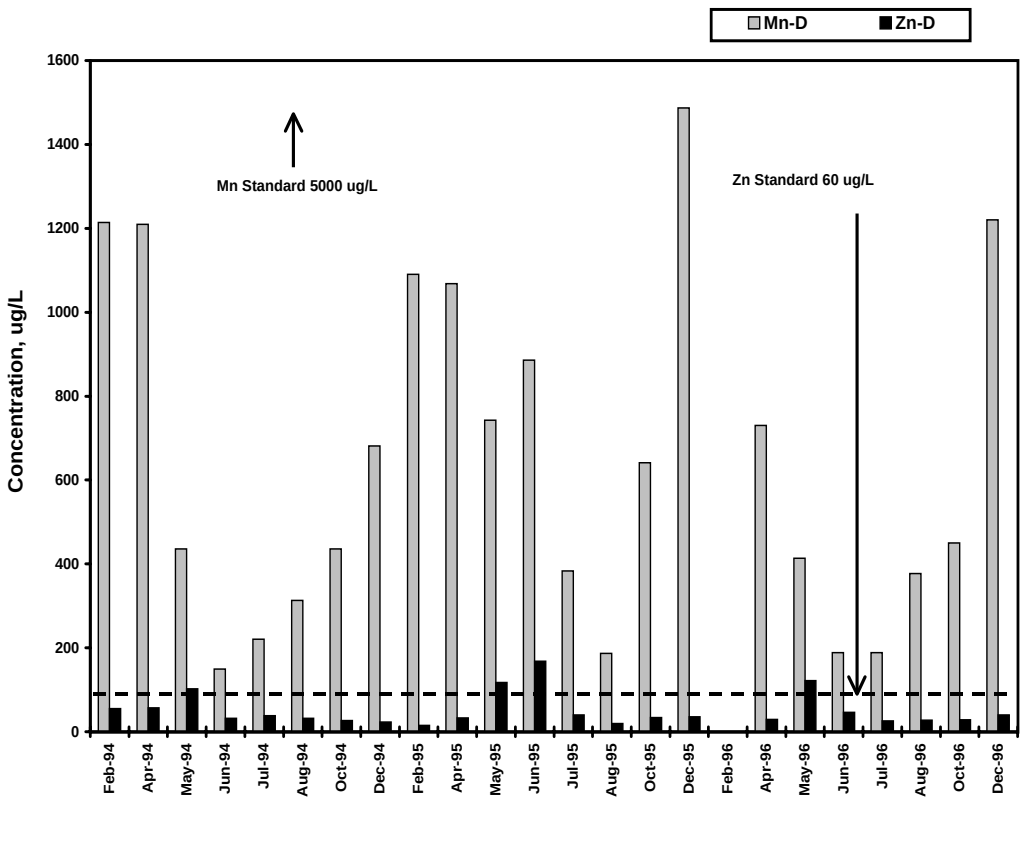
SUCCESS STORIES: *The Henderson mine is one of just a few operating molybdenum mines in the nation. The mine is located near the headwaters of the West Fork of Clear Creek. In April 1997, Cyprus-Amax, owners of the Henderson mine and the adjacent historic Urad mine, completed construction of a multi-million-dollar water treatment plant to control the metals coming from both of the mines. Dramatic improvements in the water quality of the West Fork have already been observed.*

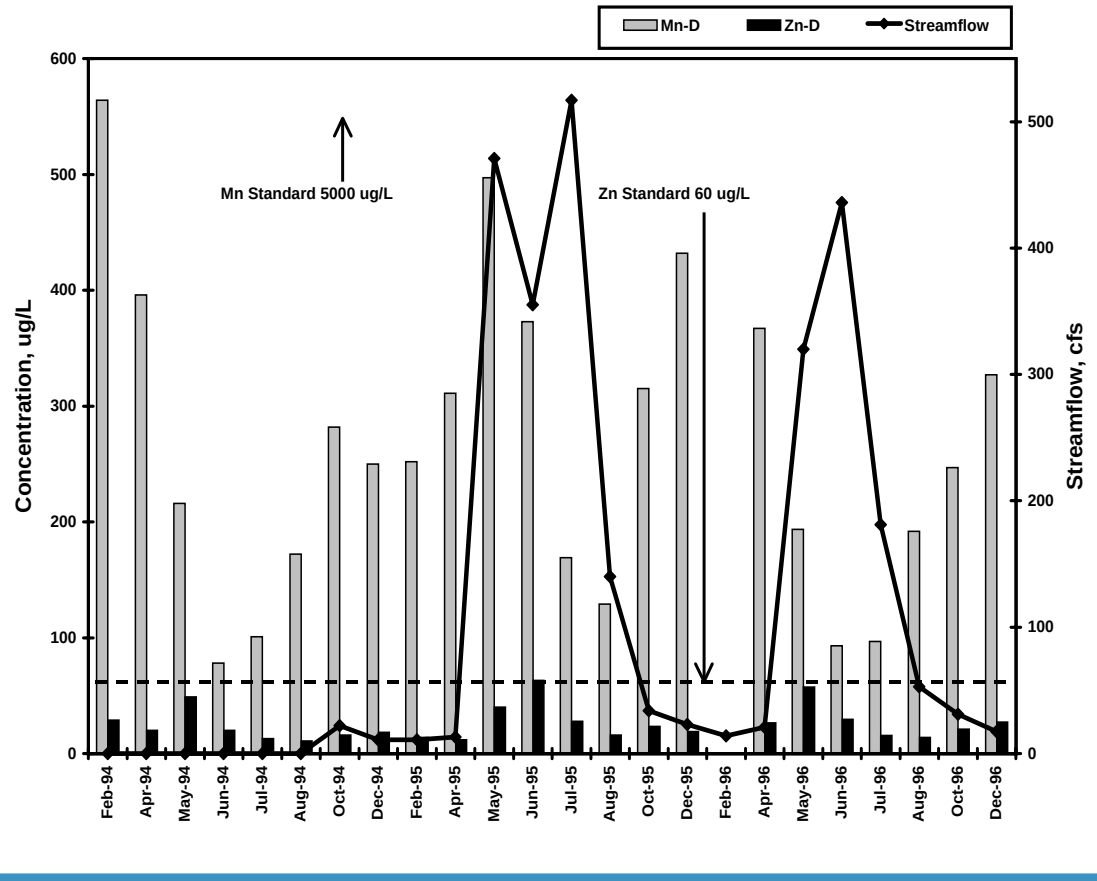
The Minnesota Mine is located on Lion Creek north of the Town of Empire. During rain storms, tailings material from the mine used to wash into Lion Creek and, subsequently, into Empire and the West Fork of Clear Creek. In 1996, CDPHE, EPA, and the USDA Forest Service funded a tailings reclamation project at the site. The agencies plan on building upon this partnership to clean up other mine sites in the watershed.

The town of Empire completed the construction of an addition to their wastewater treatment plant in January 1997. The upgrade provides nutrient removal capabilities to the plant where there were none before. This work was done in support of the effort underway by watershed stateholders to reduce nutrient-loading into Clear Creek.

DISSOLVED ZINC AND DISSOLVED MANGANESE IN THE WEST FORK DOWNSTREAM OF BERTHOUD FALLS

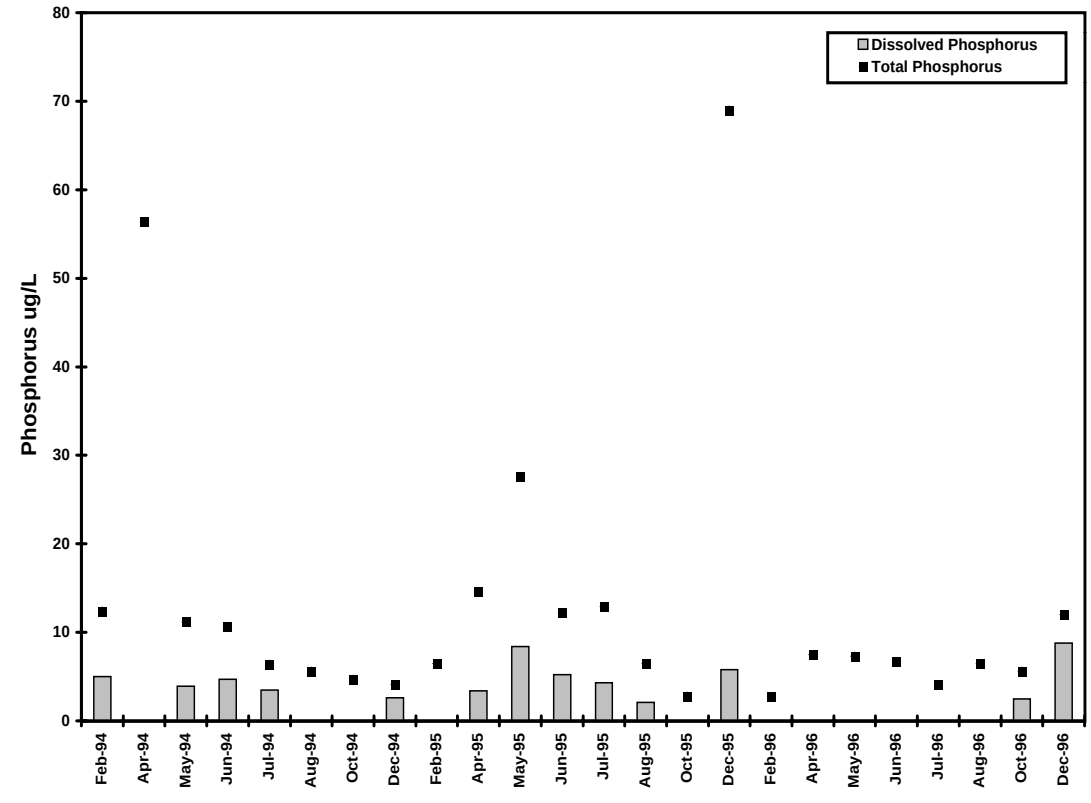
This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-15 shown on Map 11. At this location on the West Fork, manganese is the dominant metal, although the stream standard has not been exceeded at any of the monitoring events. The higher levels for manganese generally occur during the winter and pre-runoff months. The state stream standard for manganese has been set at a higher level in consideration of the elevated manganese levels in this stream segment. Zinc levels are elevated at times during the year, exceeding the state stream standard. The primary source of metals here is Woods Creek, near the locations of the Henderson and historic Urad mines. Both the manganese and the zinc standards are determined by a formula which depends upon hardness. A hardness of 100 mg/L as calcium carbonate was used to calculate the manganese and zinc standards. This monitoring station is located in Stream Segment #5 for the Clear Creek basin.





DISSOLVED ZINC AND DISSOLVED MANGANESE IN THE WEST FORK NEAR THE CONFLUENCE WITH CLEAR CREEK

This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-20 shown on Map 11. Stream flow data are available because there is a stream gage here. This station is downstream of the Berthoud Falls station (CC-15) and the levels of zinc and manganese in the river have dropped. Manganese is the dominant metal in the West Fork at this location although the stream standard has not been exceeded at any of the monitoring events. Zinc has been at or below the state stream standard as well. Both the manganese and the zinc standards are determined by a formula which depends upon hardness. A hardness of 100 mg/L as calcium carbonate was used to calculate the manganese and zinc standard. This monitoring station is located in Stream Segment #5 for the Clear Creek basin.

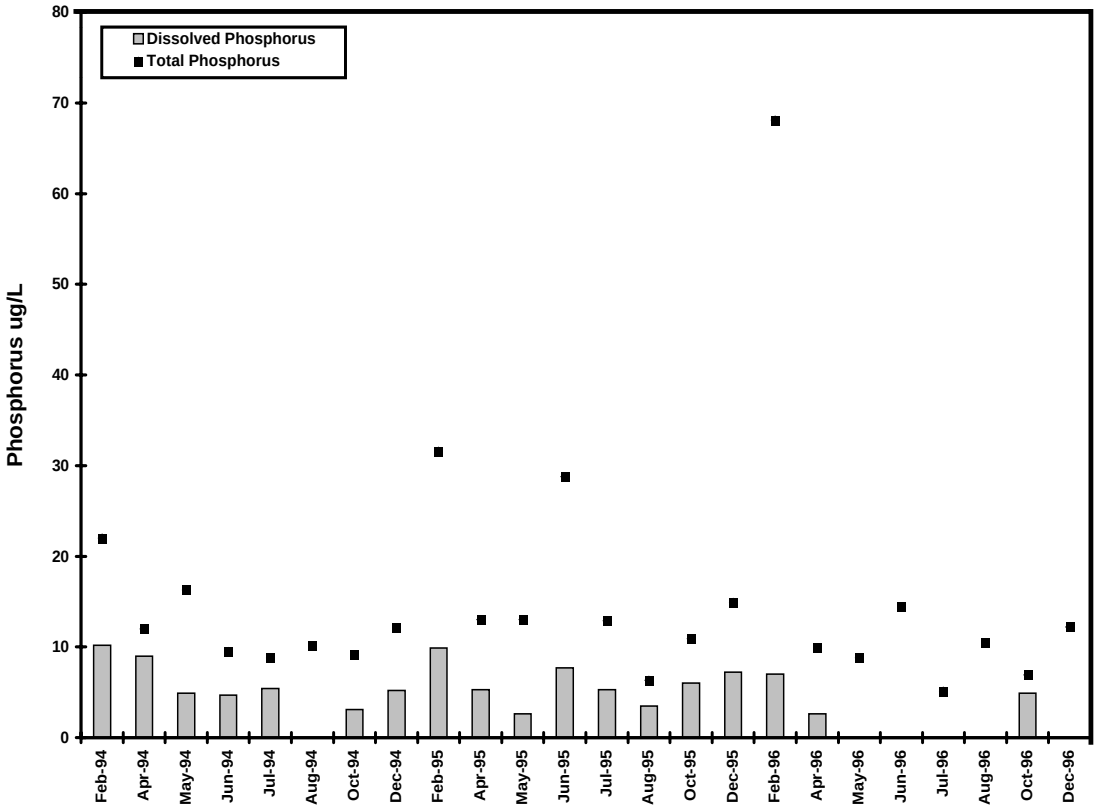


PHOSPHORUS IN THE WEST FORK DOWNSTREAM OF BERTHOUD FALLS

This graph shows dissolved and total phosphorus at monitoring station CC-15, which is located near Berthoud Falls on the West Fork. The monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on the West Fork of Clear Creek.

PHOSPHORUS IN THE WEST FORK NEAR THE CONFLUENCE WITH CLEAR CREEK

This graph shows dissolved and total phosphorus at monitoring station CC-20, which is located on the West Fork of Clear Creek near the confluence with Clear Creek. This monitoring station is below the Empire wastewater treatment plant. The monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on the West Fork of Clear Creek.



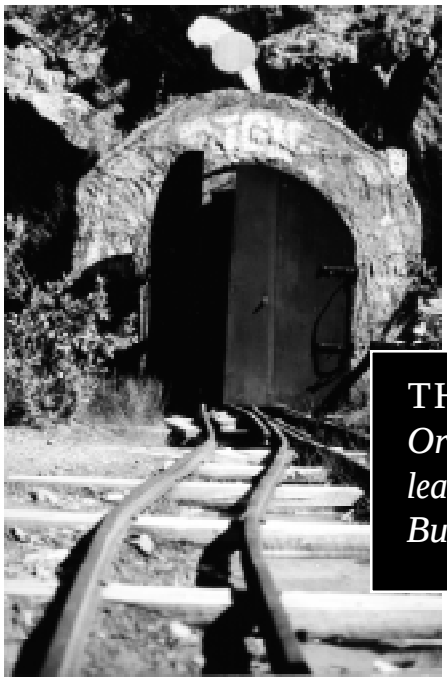
Chicago Creek

Chicago Creek is a 12-mile long tributary located southwest of Idaho Springs. Chicago Creek joins Clear Creek in Idaho Springs at the intersection of Interstate-70 and Highway 103. Highway 103 is the route to the popular Mt. Evans.
(See Map 12.)

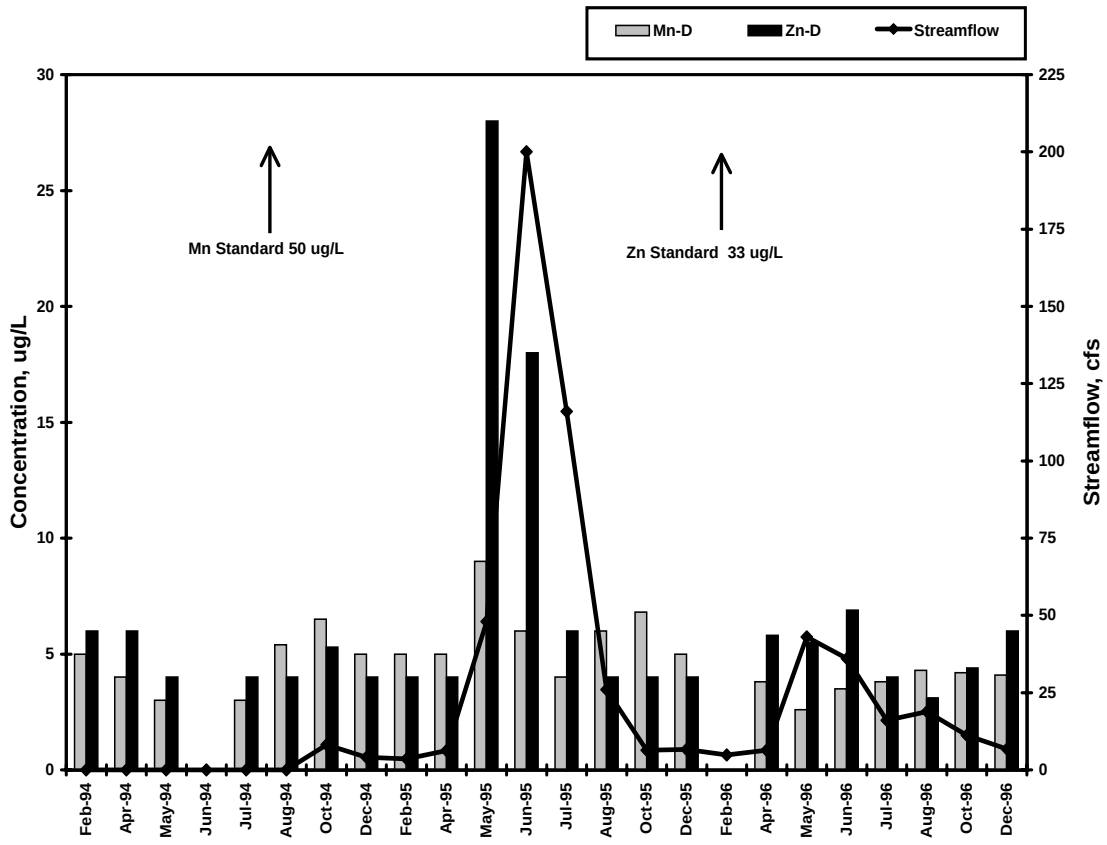
Chicago Creek is stocked with catchable rainbows from its confluence with Clear Creek up to West Chicago Creek. Other fish species found in this section include brook and brown trout. West Chicago Creek is stocked with catchable rainbows from the confluence with Chicago Creek up to the West Chicago Creek Campground. Brook trout also inhabit this stream. Chicago Lakes, which comprise the headwaters of Chicago Creek, have good populations of larger cutthroat and rainbow trout. CDOW considers Chicago Creek an important spawning area for the Clear Creek watershed.

Chicago Creek is the primary source of drinking water for the City of Idaho Springs.

SUCCESS STORY: *During heavy rainstorms, tailings from the Black Eagle mill used to wash into Chicago Creek. In 1994, Jack Pine Mining Company reclaimed the mill tailings. The company removed the toe, or base, of the mill tailings pile which had been sitting in Chicago Creek. A layer of rip-rap, consisting of large rocks, was placed at the new toe. The steep slope of the tailings pile was flattened, two ponds on top of the tailings pile were closed, and the tailings were covered with soil and seeded. Today a nice stand of native grasses grows on the reclaimed tailings. Now when it rains, the Black Eagle is no longer a problem for Chicago Creek.*

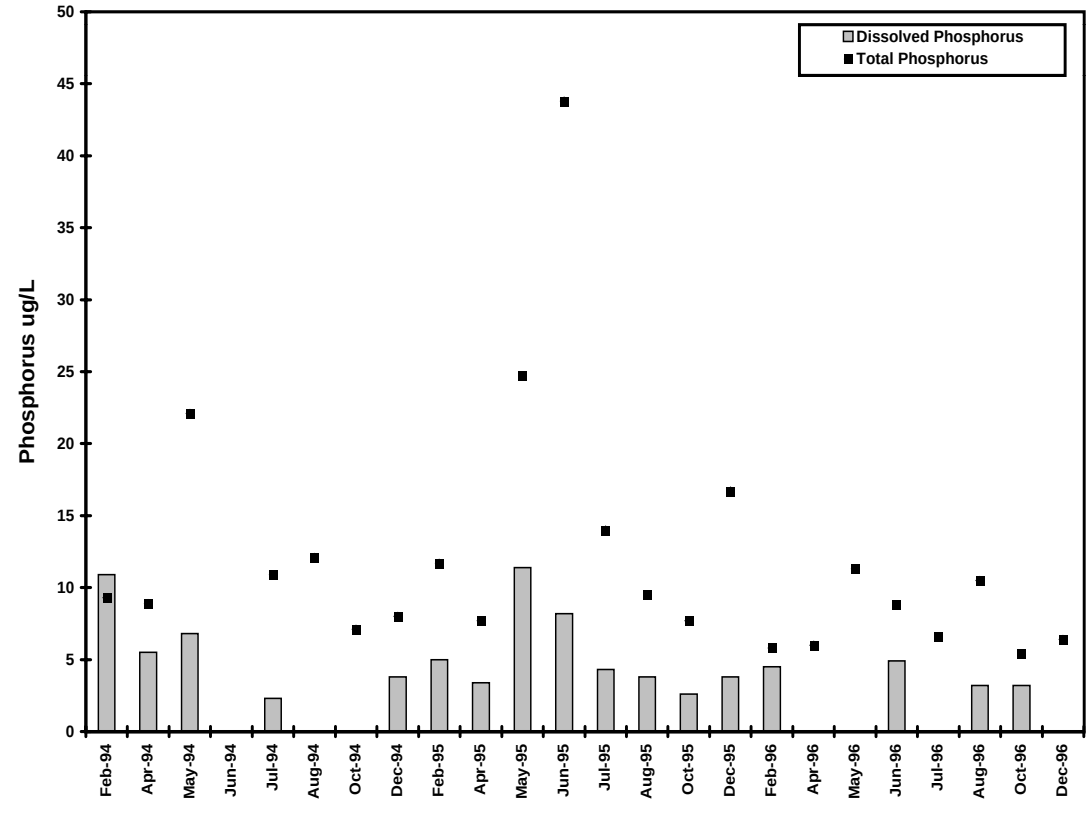


THE OLD TRACKS
Ore cart tracks lead from the Burleigh tunnel.



DISSOLVED ZINC AND DISSOLVED MANGANESE IN CHICAGO CREEK

This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-35 shown on Map 12. Stream flow data are available because there is a stream gage on Chicago Creek. This monitoring station is located in Stream Segment #10 for the Clear Creek basin. Because of the water supply designation for this stream reach, the stream standard for manganese is the same as the secondary drinking water standard of 50 ug/L.



PHOSPHORUS IN CHICAGO CREEK

This graph shows dissolved and total phosphorus at monitoring station CC-35, which is located on Chicago Creek. The monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Chicago Creek.

Fall River

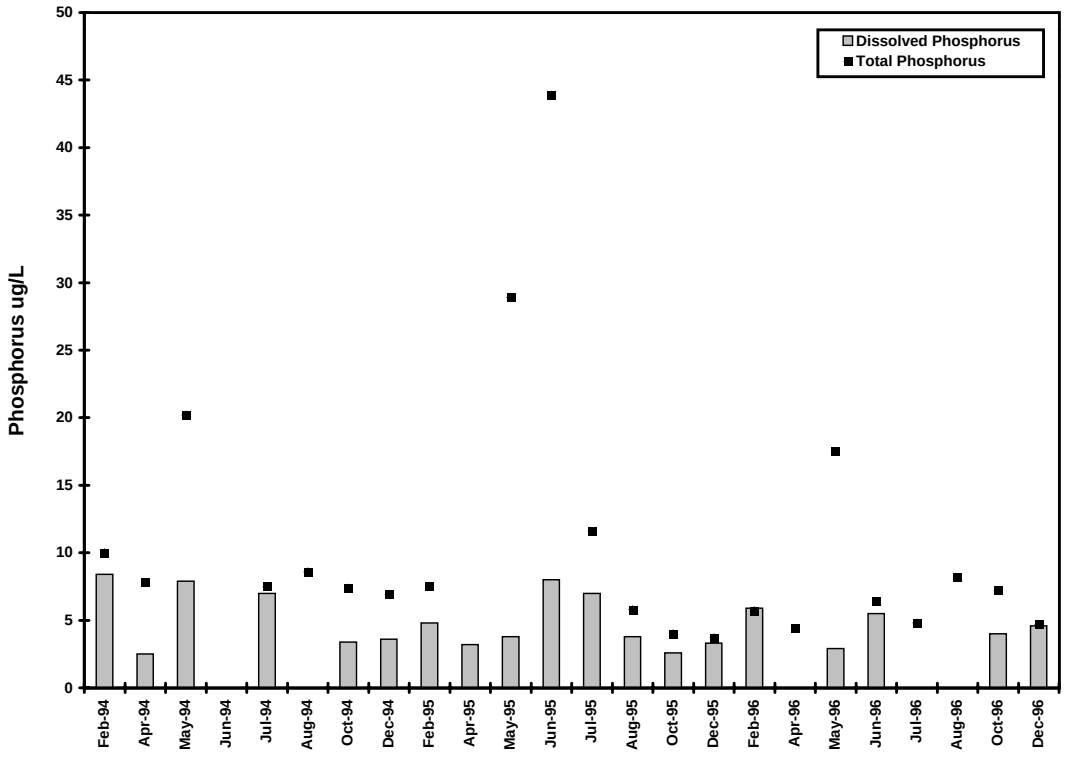
Fall River flows about eight miles from its headwaters to its confluence with Clear Creek. Silver Creek, which has headwaters near St. Mary's Glacier, is one of Fall River's larger tributaries. The former town of Alice was located on Silver Creek. (See Map 13.) Fall River has a naturally-reproducing brook and brown trout population.

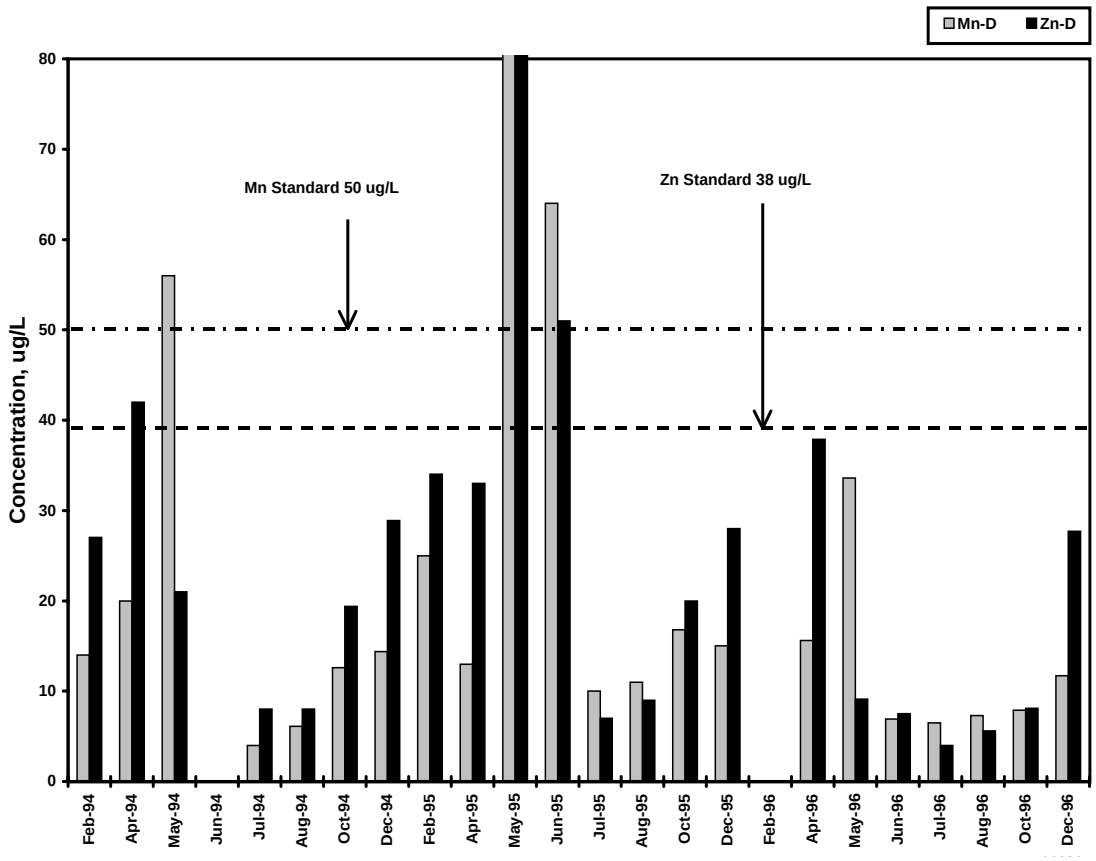
Fall River is one of the few places in the nation where a river flows into a creek.

SUCCESS STORY AND A CHALLENGE: *The Colorado Division of Minerals and Geology has been working to improve the water quality in Fall River and Silver Creek by addressing the mine contamination that exists near St. Mary's Glacier and the former town of Alice. In 1988, the Division filled in the dangerous "glory hole" in the area. A glory hole is a very large vertical mine opening. This work virtually eliminated the acid mine drainage from the glory hole. In 1996, using funding from the Non-Point Source program, the Division addressed the mill tailings which were scattered around the area, including under a trailer park at the site of Alice and in Silver Creek itself. Water quality impacts from the mill tailings were significantly reduced by the construction of french drains around the mill tailings. Initial sampling results indicate that the french drains are working. One challenge remains. There is acid mine drainage that typically flows during May and June from a mine opening. This opening used to provide access to the glory hole. The mine drainage from this lower access point has not been addressed by the Division due to Good Samaritan liability concerns discussed in Chapter V.*

PHOSPHORUS IN FALL RIVER

This graph shows dissolved and total phosphorus at monitoring station CC-30, which is located on Fall River. The nutrient monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Fall River.





DISSOLVED ZINC AND DISSOLVED MANGANESE IN FALL RIVER

This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-30 shown on Map 13. With the exception of the spring runoff in 1995, the water quality in Fall River has been very good over the last three years. The state stream standard for zinc on Fall River is quite stringent to protect this good water quality. The standard is based on a hardness of 30 mg/L as calcium carbonate. Manganese levels have been low throughout the monitoring period. This monitoring station is located in Stream Segment #9 for the Clear Creek basin. Because of the water supply designation for this stream reach, the stream standard for manganese is the same as the secondary drinking water standard of 50 ug/L.

Main Stem from West Fork to North Fork

West to North

Between the West and North Forks of Clear Creek, the river flows through the small towns of Dumont and Lawson. Trail Creek, Fall River, Chicago Creek, and Soda Creek (not to be confused with the Soda Creek in Clear Creek Canyon) are tributaries to Clear Creek in this area. Several mine tunnels with small flows, such as the McClelland, Rockford, and Big Five, add water to Clear Creek here as well. The Central Clear Creek wastewater treatment plant is located along the banks of Clear Creek in Dumont, and the Idaho Springs waste water treatment plant is situated along Clear Creek downstream of the city. The Argo Tunnel in Idaho Springs is also located in this geographic area. (See Map 12.)

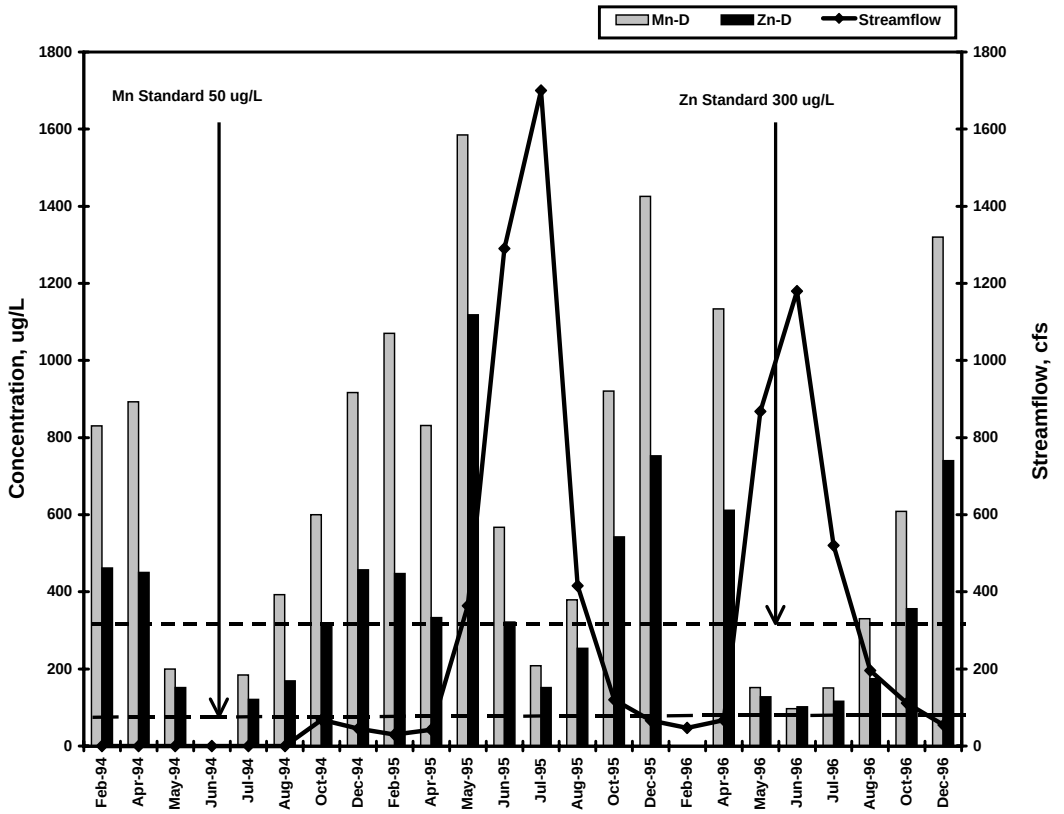
Fish species found here include rainbow, brook, brown, and cutthroat trout. Rainbow and Snake River cutthroat trout are stocked in Clear Creek from Chicago Creek upstream to the confluence with the West Fork of Clear Creek. Studies conducted by CDOW indicate that the incremental inputs of small sources of metals such as that from the McClelland mine are causing a decline in fish populations. The area downstream of the Argo Tunnel is heavily impacted by metals, so only a few rainbow, brown, and brook trout are found.

A SUCCESS STORY AND A CHALLENGE: *The acid mine drainage coming from the Argo Tunnel in Idaho Springs is the single largest point source of metals to Clear Creek. The tunnel adds about 740 pounds of metals to the river daily. The water is also acidic. CDPHE and EPA, through the Superfund program, have built a water treatment plant at the Argo. The plant should begin operating in December 1997, at which time water quality in Clear Creek is expected to improve significantly.*

A challenge remains, however. Water quality investigations of Clear Creek through Idaho Springs reveal that there is a large, yet diffuse, load of metals entering Clear Creek from groundwater exiting Virginia Canyon. This load, in terms of pounds of metals per day, is equal to or greater than that of the Argo Tunnel. Once the Argo Tunnel treatment plant is operating, CDPHE and EPA plan to investigate the groundwater in Virginia Canyon to determine if it can be captured before it reaches Clear Creek. If this effort is successful, then the groundwater will be treated at the Argo Tunnel treatment plant.

DISSOLVED ZINC AND DISSOLVED MANGANESE IN CLEAR CREEK DOWNSTREAM OF IDAHO SPRINGS

This graph shows data collected via the Upper Clear Creek Watershed Association, Standley Lake Cities, and EPA joint monitoring program. Data are for monitoring station CC-40 shown on Map 12. Stream flow data are available because there is a stream gage at this monitoring station. This monitoring station is downstream of Idaho Springs and, hence, shows the influence of the Argo Tunnel drainage on Clear Creek. The state stream standards for both manganese and zinc are exceeded frequently especially during low flow winter months and during spring runoff. This monitoring station is located in Stream Segment #11 for the Clear Creek basin. Because of the water supply designation for this stream reach, the stream standard for manganese is the same as the secondary drinking water standard of 50 ug/L.



PHOSPHORUS IN CLEAR CREEK DOWNSTREAM OF IDAHO SPRINGS

This graph shows dissolved and total phosphorus at monitoring station CC-40, which is located on Clear Creek downstream of the Idaho Springs wastewater treatment plant. The nutrient monitoring is being conducted by the Upper Clear Creek Watershed Association and the Standley Lake Cities. There is no state stream standard for phosphorus on Clear Creek.